

## CLAIMS

We Claim:

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- 10 1. A programmable alarm clock system for waking a sleeper during an selected period of sleep, said programmable alarm clock system comprising:  
at least one sleep activity sensor attachable to a head of a sleeper;  
a receiver receiving sleep activity signals from sensors attached to heads of sleepers;  
a local computer receiving a wake up time from a user and sending said received sleep activity signals to a remotely connected sleep analyzing server;  
a remotely triggered local alarm device sounding an alarm to wake a sleeper responsive to a determination from said local computer that said sleeper should be awoken.
- 15 2. A programmable alarm clock system as in claim 1, wherein said sleep activity is brain activity and said sleep analyzing server analyzes received brain activity signals and identifies periods of slow wave sleep.
3. A programmable alarm clock system as in claim 1, wherein said sleep activity is brain activity and said sleep analyzing server analyzes received brain activity signals and identifies periods of REM sleep and non-REM sleep.
- 20 4. A programmable alarm clock system as in claim 1, wherein said at least one sensor measures brain activity using electroencephelography.

5. A programmable alarm clock system as in claim 1, wherein said at least one sensor measures brain activity using polysomnography.

6. A programmable alarm clock system as in claim 1, wherein said activity is brain activity and said at least one sensor is a plurality of sensors in wireless communication with said local computer.

7. A programmable alarm clock system as in claim 1, wherein said sleep activity is eye movement and eyelid sensors are attached to said sleeper's eyelids measuring said eye movement, said receiver receiving sensor signals from said eyelid sensors.

8. A programmable alarm clock system as in claim 1, wherein said user further provides said local computer with a selected sleep activity, the server sending information about identified periods of said selected sleep activity to said local computer and said local computer determines from received said information when to trigger an alarm relative to said wake up time from said user.

9. A programmable alarm clock system as in claim 8, wherein when said local computer determines that said sleeper is in an identified period of said selected sleep activity at said user's wake up time, said local computer triggers an alarm.

10. A programmable alarm clock system as in claim 9, wherein when said local computer determines that said sleeper is in an other sleep activity period identified as having a sleep activity other than said selected sleep activity at said user's wake up time, said local computer triggers an alarm at an end to said other sleep activity period.

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11. A programmable alarm clock system as in claim 9, wherein when said local computer determines that said sleeper is in an other sleep activity period identified as having a sleep activity other than said selected sleep activity at said user's wake up time, said local computer postpones triggering an alarm until a next selected sleep period.

5 12. A programmable alarm clock system as in claim 10 wherein when said local computer determines that said sleeper is in an other sleep activity period identified as having a sleep activity other than said selected sleep activity at said user's wake up time, if said local computer determines that the next selected sleep activity period is expected to occur beyond a user selected margin, said local computer triggers said alarm.

10 13. A programmable alarm clock system as in claim 8, wherein said selected sleep activity is REM sleep.

14. A programmable alarm clock system as in claim 8, wherein said selected sleep activity is non-REM sleep.

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15 15. A programmable alarm clock system as in claim 6 wherein the server comprises:  
a receiving module receiving sleep activity;  
a signal analyzer charting sleep data and identifying sleep periods as being either selected activity sleep periods or other activity sleep periods;  
a signal labeler labeling selected activity sleep periods and other activity sleep periods; and  
20 a sender sending labeled said charts to the local computer.

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16 A programmable alarm clock system as in claim 15 further comprising:  
a signal processing unit receiving analog signals representative of said sleep  
activity and providing digital sleep data to the signal analyzer responsive to said analog  
signals.

5 17. A programmable alarm clock system as in claim 16, further comprising:  
one or more sensors attached to the head of a sleeper, each of said one or more  
sensors sending sleep activity signals to said receiving module.

18. A programmable alarm clock system as in claim 17, wherein at least one of said  
one or more sensors is attached to the head of said sleeper sensing brain activity.

10 19. A programmable alarm clock system as in claim 18, wherein the signal analyzer  
identifies sleep periods based upon selected brain activity prototypes.

20. A programmable alarm clock system as in claim 17, wherein at least one of said  
one or more sensors is attached to the eyelids of said sleeper sense eye movement.

15 21. A method of operating a programmable alarm clock, said method comprising the  
steps of:

- a) receiving sleep activity signals from a sleeper;
- b) digitizing said sleep activity signals;
- c) analyzing said digitized sleep activity signals to identify selected sleep  
activity periods and other sleep activity periods;
- 20 d) waiting for a designated wake up time;

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- e) determining whether said sleeper is in a period of said selected sleep activity or a period of other sleep activity at said designated wake up time; and
- f) sounding an alarm at said designated wake up time if said sleeper is in a period of said selected sleep activity.

5 22. A method of operating a programmable alarm clock as in claim 21, when said sleeper is determined to be in said other sleep activity period at said alarm time, said method further comprising the steps of:

- g) determining an alarm time to sound said alarm; and
- h) sounding said alarm at said alarm time.

10 23. A method of operating a programmable alarm clock as in claim 22, wherein the determining step (g) comprises the steps of:

- i) determining whether a wait margin has been selected, the alarm time being set to said designated wake up time when no wait margin has been selected;
- ii) setting the alarm time as the time that the sleeper will enter a selected sleep activity period if the sleeper will enter a selected sleep activity period within the wait margin; and
- 15 iii) if the sleeper will remain in the other sleep activity during said wait margin, setting said alarm at the end of said wait margin.

20 24. A method of operating a programmable alarm clock as in claim 23, wherein the sleep activity signals received in the receiving step (a) are brain activity signals and the brain activity signals are sent to a remotely connected server.

25. A method of operating a programmable alarm clock as in claim 24, wherein the analyzing step (c) comprises the steps of:

- i) creating a prototype chart of said digitized brain activity signals; and
- ii) labeling periods in said prototype chart as being selected sleep activity periods and other sleep activity periods.

26. A method of operating a programmable alarm clock as in claim 25, wherein said labeled prototype chart is sent to a local computer.

27. A method of operating a programmable alarm clock as in claim 26, wherein in the step (e) of determining whether the sleeper is in a selected sleep activity period, said local computer interrogates the labeled prototype chart, determining therefrom whether the designated wake up time is in one of the labeled selected sleep activity periods.

28. A method of operating a programmable alarm clock as in claim 27, wherein the local computer sends a trigger to an alarm clock in the steps (f) and (h) of sounding the alarm, the alarm clock sounding the alarm responsive to said trigger.

29. A method of operating a programmable alarm clock as in claim 28, wherein the selected sleep activity is non-REM sleep.

30. A method of operating a programmable alarm clock as in claim 28, wherein the selected sleep activity is REM sleep.

31. A method of operating a programmable alarm clock as in claim 28, wherein the selected sleep activity is slow wave sleep.

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32. A computer program product for operating a programmable alarm clock system, said computer program product comprising a computer usable medium having computer readable program code thereon, said computer readable program code comprising:

computer readable program code means for receiving sleep activity signals from a sleeper;

computer readable program code means for digitizing said sleep activity signals;

computer readable program code means for analyzing said digitized sleep activity signals to identify selected sleep periods and non-selected sleep periods;

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computer readable program code means for determining an alarm time responsive to whether said designated wake up time is in a selected sleep period or non-selected sleep period; and

computer readable program code means for sounding an alarm responsive to a trigger.

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33. A computer program product for operating a programmable alarm clock system as in claim 32, wherein said computer readable program code means for determining an alarm time comprises:

computer readable program code means for determining whether a wait margin has been selected, the alarm time being set to said designated wake up time when no wait margin has been selected;

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computer readable program code means for setting the alarm time as the time that the sleeper will enter a selected sleep activity period if the sleeper will enter a selected sleep activity period within the wait margin; and

computer readable program code means for setting said alarm at the end of said wait margin, if the sleeper will remain in a non-selected sleep activity during said wait margin.

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34. A computer program product for operating a programmable alarm clock system as in claim 33, further comprising:

computer readable program code means for forwarding received sleep activity signals to a remotely connected server.

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35. A computer program product for operating a programmable alarm clock system as in claim 34, wherein the sleep activity signals are brain activity signals and said computer readable program code means for analyzing digitized brain activity comprises:

computer readable program code means for creating a prototype chart of said digitized brain activity signals;

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computer readable program code means for labeling periods in said prototype chart as being selected sleep periods and non-selected periods; and

computer readable program code means for sending said labeled prototype chart to a local computer.

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36. A computer program product for operating a programmable alarm clock system as in claim 35, wherein said computer readable program code means for sounding said alarm comprises:

computer readable program code means for causing said local computer to send a trigger to a local alarm device.

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37. A computer program product for operating a programmable alarm clock system as in claim 34, wherein said sleep activity signals indicate eye movement.

38. A computer program product for operating a programmable alarm clock system as in claim 37 wherein said selected sleep activity is REM sleep.



